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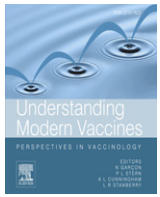
Understanding Modern Vaccines:
Perspectives in Vaccinology



Preface

Miss Jennings dies, the third nurse to make supreme sacrifice

> "Miss Jennings, a nurse, died at the Glendale hospital Thursday evening at 6 o'clock. Miss Jennings took sick with influenza several days ago and grew worse until the end came last evening. She was 22 years of age and was in her second year of training. This is the third nurse that has died at the hospital this week of influenza. They paid the supreme sacrifice while caring for the sick of the community. Each girl worked as long as she could be on her feet, regardless of her own feelings. Miss Wright, another nurse, is not expected to survive the day, of influenza."
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> *Moundsville [West Virginia] Weekly Echo* — 6 December 1918

For most of our history, humans could do little to protect themselves against infectious diseases as dramatically illustrated by the influenza pandemic of 1918–1919. However, over the past four centuries vaccines have had an immeasurable impact on

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human health. In the 18th century the development of the vaccinia virus vaccine provided a safe approach to protect against the deadly scourge of smallpox. In the 19th century fundamental discoveries in microbiology and immunology led to a basic understanding of how vaccines protect against infectious diseases. Work by Louis Pasteur, Émile Roux and others showed that vaccines containing inactivated or attenuated microbes could protect against ancient afflictions like rabies, cholera and typhoid. The pace of scientific innovation accelerated in the 20th century in parallel with the development of new vaccines. Novel methods for producing vaccine antigens, including cell culture systems and genetic engineering, were invented and new ways of enhancing vaccine potency, including adjuvants and carrier protein conjugation, were discovered. Between 1913 and 1997, new vaccines for 20 diseases became available that provided defence against feared childhood diseases, such as diphtheria, pertussis, measles and *Haemophilus influenzae* type b infection, and other worldwide killers, including influenza, polio and hepatitis B virus. In the first decade of the 21st century alone, 10 new vaccines have been licensed including the first therapeutic vaccine for a viral infection (herpes zoster), the first adjuvanted prophylactic cancer vaccines (human papillomavirus), the first therapeutic cancer vaccine (prostate cancer), and the first intranasal vaccine (influenza).

New technologies, new discoveries and greater understanding of human immunology and microbial pathogenesis will continue to facilitate the development of new and improved vaccines. The field of vaccine research and development has grown increasingly sophisticated and complex. This new textbook, written by internationally recognised vaccine experts, provides a comprehensive overview of the essential aspects of vaccine development. The six chapters of this book examine the fascinating history of vaccine development, provide a comprehensible review of vaccine immunology, elucidate the science of vaccine antigens and vaccine adjuvants, clarify the complex vaccine development pathway from concept to testing to licensure and implementation,

and finally the book explores the near future describing the exciting developments that promise to deliver new vaccines for known and yet to be discovered targets as well as vaccines for non-traditional targets such as autoimmune diseases, malignancies and addiction.

The editors would like to acknowledge the generations of vaccine researchers whose determination, commitment and brilliance have made the world a better and safer place.

Nathalie Garçon PharmD, PhD
Peter L Stern PhD
Anthony L Cunningham MBBS, MD
Lawrence R Stanberry MD, PhD